

# 5 GHz RF Modem User Manual

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Document Number 4050-9901

Rev Number 04

Date 07-Feb-2006

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## Revision History

| Rev | Date        | Author                | Comments  |
|-----|-------------|-----------------------|---|
| 01  | 16-Aug-2005 | M. Smutek / R. Hughes | Preliminary version   |
| 02  | 14-Nov-2005 | M. Smutek             | Revisions & additional commands   |
| 03  | 17-Jan-2006 | M. Smutek / R. Hughes | Additional commands and updates, MIB, licenses, warranty, installation & configuration  |
| 04  | 07-Feb-06   | M. Smutek / R. Hughes | Glossary. RF radiation warning. Miscellaneous clarifications and editorial corrections. |
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## **FCC COMPLIANCE STATEMENT**

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's expense.

## **WARNING RF EXPOSURE HAZARD**

Under certain operational circumstances and when connected to a typical high gain directional antenna, this equipment is capable of producing RF radiation exposure in excess of the limits defined in FCC 47CFR 1.1310, Table 1. Personnel working in the vicinity of an energized antenna should ensure that they maintain a distance of at least 4.2 feet (1.28 meters) from the antenna in the direction of maximum gain. All antenna maintenance activities should be performed only when the associated RF Modem transmit power has been muted.

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To allow for the introduction of design improvements, specifications are subject to change without notice.

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# 1 Introduction

## 1.1 System Overview

The Model 4050 is a 5 GHz full-duplex Radio Frequency (RF) modem with link speeds of 64 and 128 Kbps. Data formats are synchronous serial, asynchronous serial, and 10Base-T Ethernet.

## 1.2 Features

### Radio

- 5 GHz operation (5.091 – 5.101 and 5.140 – 5.150 GHz)
- Transmit power: 1W up to 50°C
- Occupied bandwidth: 100 KHz @ 64 Kbps, 200 KHz @ 128 Kbps
- Sensitivity: -98 dBm @ 64 Kbps, -96 dBm @ 128 Kbps
- Dynamic range: 70 dB
- Point-to-point
- Point-to-multipoint (TX keyed by RTS)

### Modem

- Link speed: 64 or 128 Kbps (automatically set by data interface)
- Error correction: Reed-Solomon
- Interleave depth: 0 to 6

### Data Interfaces

- Serial: synchronous or asynchronous (software selectable)
- Synchronous speeds: 64 or 128 Kbps
- Synchronous clock: internal, external, or looped (software selectable)
- Asynchronous speeds: 300 – 19200 bps
- Interface: EIA-232 and EIA-530 (software selectable)
- DB-25F connector (DCE)
- Ethernet 10Base-T (layer 2, protocol independent)

### Management

- Local serial port (9600, 8N1)
- DE-9F (DCE)
- Command line interface
- Password protected (three authorization levels)
- Alarm status LEDs (front and rear panels, four each)
- Alarm contact closures (solid-state, four form A)
- Ethernet 10Base-T management port
- DHCP capable
- SNMP (v1 and v3)

## 2 Installation and Configuration

### 2.1 General Installation and Operating Considerations

#### 2.1.1 Antenna

Avoid operating the transmitter without a proper termination on the RF connector. Although the modem is designed to withstand such operation, undesired interference to other RF systems may occur.

A typical installation will require the use of a high gain antenna. Proper alignment of the antenna is critical to ensuring an error-free link. During the alignment process, an **rs1** command from the Craft Interface Terminal (CIT) will display near real-time receive signal strength and may be used to “peak” the antenna positioning.

This equipment produces RF radiation when connected to a typical high gain directional antenna. Personnel working in the vicinity of an energized antenna should ensure that they maintain a distance of at least 4.2 feet (1.28 meters) from the antenna in the direction of maximum gain. See the caution statement at the beginning of the manual.

The RF Modem is shipped with the transmitter set in the “mute” condition. This is done to prevent inadvertent transmission on an unauthorized frequency. All operating parameters, including an estimate of the minimum necessary transmit power, should be programmed into the modem before un-muting the transmitter.

Do not exceed +10 dBm input power at the antenna terminal of the RF Modem or damage to the unit may result.

#### 2.1.2 Site Planning

As with any wireless link, proper system and path planning is essential to ensuring error-free operation. Such planning should take into consideration path clearances from obstructions, interference from nearby radiators, multi-path reflections and fading. A system signal strength margin of at least 20 dB above the rated receiver threshold is standard practice.

When installing multiple modems in the same general location, ensure that they are all transmitting within the same sub-band to prevent interference and desensitization.

#### 2.1.3 Cooling

Install the RF Modem so that adequate airflow can be maintained through the rear and side vents. If airflow is restricted, the modem internal temperature may rise above the preset thermal shutdown temperature.

#### 2.1.4 Shielding and Grounding

When the DB-25F connector is used for the RF Modem EIA-530/232 data I/O, ensure that a good quality shielded cable is used and that the cable shield is electrically terminated to the cable connector shells.

A grounding stud is provided on the rear panel. A ground braid should be attached to this lug and connected to a local earth ground to prevent static charge build-up on the modem, antenna and associated cabling.

### 2.2 Configuration Procedure

#### 2.2.1 Password Setup

As shipped from the factory, the default passwords are trivial and not secure. It is strongly suggested that the passwords be changed before the system is deployed.

To change passwords, log in to the system as the administrator by typing the default administrator password “admin” at the password prompt.

### ***2.2.1.1 Operator Password***

The operator password allows the operator to configure and test the data port. Configuration settings for the radio and the network may be displayed but not changed.

The initial operator password is “oper”. The operator or the administrator may change it using the password command:

```
> passwd oper
```

### ***2.2.1.2 Administrator Password***

The administrator password allows the administrator to configure all of the modem including the data port, radio and network.

The initial administrator password is “admin”. The administrator may change it using the password command:

```
> passwd admin
```

The administrator may also change the operator password (and the spare password).

### ***2.2.1.3 Spare Password***

The spare password is equivalent to the administrator. It is intended as an extra password that may be used in the event that the administrator password is lost.

The initial spare password is “spare”. The administrator may change it using the password command:

```
> passwd spare
```

### ***2.2.1.4 Privileged Password***

The privileged password is intended for use by a service technician. It allows access to all the operator and administrative commands plus commands for updating the software and examining various factory-set parameters.

The initial privileged password is “Volpe.DOT.”. The privileged user may change the password using the command:

```
> password wheel
```

The privileged user may also change the operator, administrator, and spare passwords as shown above.

## **2.2.2 Radio Configuration**

A configuration summary with all of the important configuration settings for the radio and the data interface may be displayed with the **config** command.

### ***2.2.2.1 Dash Setting***

The modems come in two configurations known as “dash one” and “dash two.” The “dash one” modems transmit at a lower frequency than they receive while the “dash two” modems are the reverse. One modem of each type is required to form a link.

Modems with odd serial numbers are set at the factory to “dash one” and those with even serial numbers are set to “dash two.”

IMPORTANT: The dash setting corresponds to a physical configuration internal to the modem and should not be changed.

#### **2.2.2.2 Receive Frequency**

The receive frequency should be set with the command:

```
> rxfreq ffff.f
```

The receive frequency of each modem must equal the transmit frequency of the other modem in the link. The frequency is specified in 0.1 MHz steps.

#### **2.2.2.3 Transmit Frequency**

The transmit frequency should be set with the command:

```
> txfreq ffff.f
```

The transmit frequency of each modem must equal the receive frequency of the other modem in the link. The frequency is specified in 0.1 MHz steps.

#### **2.2.2.4 Transmit Power**

The transmit power should be set with the command:

```
> txpower nn.n
```

The transmit power level is specified in dBm, adjustable in 0.5 dB steps.

#### **2.2.2.5 RSL Threshold**

The RF Modem has a programmable Receive Signal Level (RSL) threshold detector that may be used to evaluate link margin. When the receive signal level drops below the programmed threshold, the RX alarm will be set. This threshold is set at the factory to a default value of -110 dBm to minimize the chance of inadvertent RSL alarms during initial system setup. The user should set the RSL alarm threshold so that RSL alarm events are generated at an appropriate level depending on the actual operating conditions.

The RSL threshold should be set with the command:

```
> rslthr -nn.n
```

The threshold value is specified in dBm.

#### **2.2.2.6 Mute**

The modem is configured at the factory with mute on. Mute should not be turned off until the frequency and power settings are set correctly and an appropriate antenna (or load) is attached to the antenna terminal.

##### **2.2.2.6.1 Data Channel Configuration**

### 2.2.2.7 *Channel Selection*

The modems may be configured to carry either full-duplex serial or Ethernet traffic. Only one type of traffic can be carried at a time and both ends of the link must be set to the same selection. Configure the channel with the command

```
> channel serial
```

or

```
> channel ethernet
```

as desired.

### 2.2.2.8 *Serial Port*

The DB-25 connector carries the serial data traffic. It may be configured through the software for either synchronous or asynchronous operation at a variety of speeds, and for either EIA-530 or EIA-232 drivers and receivers.

The serial port should be properly configured before connecting to external equipment.

#### 2.2.2.8.1 Speed

Serial data may be either synchronous at 64 or 128 Kbps, or asynchronous at 300 to 19200 bps. The speed selection automatically determines whether the protocol is synchronous or asynchronous.

Both ends of the link must be set to the same speed.

The speed and protocol may be set to 64 or 128 Kbps synchronous with the command:

```
> speed 64
```

or

```
> speed 128
```

The speed and protocol may be set to 300 to 19200 bps asynchronous with the command:

```
> speed 300
```

where the 300 may be replaced with 600, 1200, 2400, 4800, 9600, 14400, or 19200 as desired.

#### 2.2.2.8.2 Clock Source

Synchronous serial mode requires the use of a data clock for both receive data and transmit data. The receive data clock is always derived from the received signal and is provided by the modem. The transmit clock, however, may be provided by one of three sources. With the clock set to internal, the modem supplies a clock at 64 Kbps or 128 Kbps depending on the speed setting. With the clock set to external, the customer equipment supplies a 64 or 128 Kbps clock that should match the speed setting. With the clock set to loop, the receive clock is also used for the transmit side.

The clock mode of the modem at each end of the link must be configured appropriately depending on the clock mode of the customer equipment to which it is attached. For example, if the customer equipment is generating the transmit clock, the modem must use the external clock mode. On the other hand, if the customer equipment is expecting the clock to be provided by the modem, then the modem must be set to internal clock mode. Each end of the link may be configured independently to use internal, external, or looped clock, except that using looped mode at both ends of the link is not recommended.

The clock source may be set with one of the commands:

```
> clock int
```

or

```
> clock ext
```

or

```
> clock loop
```

#### 2.2.2.8.3 Interface Type

The serial interface may use either EIA-232 or EIA-530 drivers and receivers. Either type of interface may be used with both synchronous and asynchronous data.

Each end of the link may be configured independently.

The interface type may be configured with the command

```
> interface 232
```

or

```
> interface 530
```

#### 2.2.2.9 *Ethernet Port*

The Ethernet data port requires no configuration. When the Ethernet channel is selected, the link speed is automatically set to 128 Kbps.

The Ethernet data port attempts to transport any valid Ethernet packet it receives to the other end of the link. No assumption is made about higher layer protocols and, in particular, there is no assumption that Internet Protocol (IP) is used. The Ethernet data port needs no IP address, netmask, or default gateway.

Since the modem link is slower than the Ethernet network, packets may arrive at the port faster than they can be transmitted across the link. In this case the modem will buffer and transmit as many packets as possible but some packets may be lost. This is consistent with ethernet's "best effort" deliver policy. If guaranteed delivery is required, a higher layer protocol such as Transmission Control Protocol (TCP) will assure delivery even when there is packet loss due to congestion or mis-matched link speeds.

### 2.2.3 Remote Management Port Configuration

The Ethernet Remote Management System (RMS) port is used for Simple Network Management Protocol (SNMP), software updates, system message logging, and setting the system clock. All of these functions are optional and, if they are unused, the port may be left un-configured and unconnected.

If any of these features are desired, the port should be properly configured before being connected to the local network. Failure to properly configure the port may cause the port to not operate and/or interfere with the operation of other devices on the local network.

A network configuration summary may be displayed with the **netconfig** command.

### **2.2.3.1 DHCP**

The IP parameters of the interface may be automatically configured using a Dynamic Host Configuration Protocol (DHCP) server on the local network. The DHCP server will typically configure the IP address and netmask, default gateway, and Domain Name Servers (DNS).

To enable use of a DHCP server, use the command:

```
> dhcp on
```

To disable the use of a DHCP server, use the command:

```
> dhcp off
```

### **2.2.3.2 IP Address / Netmask**

Each device on the local network requires a unique IP address. If the IP address and netmask are configured with DHCP, the manual IP address and netmask are not used.

To set the IP address, use the command

```
> ip aaa.bbb.ccc.ddd
```

where aaa.bbb.ccc.ddd is the desired IP address in the usual “dotted quad” format.

To set the netmask, use the command

```
> netmask aaa.bbb.ccc.ddd
```

where aaa.bbb.ccc.ddd is the desired netmask in the usual “dotted quad” format.

### **2.2.3.3 Default Gateway**

When the local network includes one or more routers connecting to other networks, a default gateway should be specified to indicate which is the most likely router to handle traffic to arbitrary IP addresses.

If DHCP is enabled, this manual setting is not used.

To set the default gateway, use the command

```
> gateway aaa.bbb.ccc.ddd
```

where aaa.bbb.ccc.ddd is the IP address of the default router in the usual “dotted quad” format.

### **2.2.3.4 DNS Servers**

If either the timeserver or loghost (see following) are specified by name rather than IP number then a DNS is needed to resolve the name.

If DHCP is enabled, then the DNS may be set automatically. However, if DHCP is disabled or if it does not designate a DNS server, then the manual setting will apply.

Two DNS server may be specified, in which case the secondary server is used in the event the primary server is unavailable.

To set the DNS server use the commands:

```
> dns pri aaa.bbb.ccc.ddd
```

```
> dns sec eee.fff.ggg.hhh
```

### 2.2.3.5 *Timeserver*

The modem does not have real-time clock hardware that will allow it to maintain a time reference when powered off. However, during its startup procedure it will attempt to contact a timeserver on the network to set its clock to the actual time. The time is only used for message logging and other diagnostic purposes and a correct time is merely a convenience. Consequently, the availability of a timeserver is completely optional.

The factory set timeserver is `us.pool.ntp.org`, which refers to a collection of public timeservers generally available on the Internet. A DNS server must be available to resolve that timeserver name into an IP address.

The protocol used to set the time is NTP (network time protocol). Any NTP server may be used as a timeserver.

To change the timeserver use the command:

```
> timeserver aaa.bbb.ccc.ddd
```

or

```
> timeserver hostname.domainname
```

where `aaa.bbb.ccc.ddd` is the IP address of the timeserver in the usual “dotted quad” format, or `hostname.domainname` is the hostname and domain name. Note that there is no default domain name so it must be explicitly specified with the hostname.

### 2.2.3.6 *Loghost*

The modem can send system log messages to a specified loghost. This feature is mainly intended for debugging purposes and a loghost is completely optional. Normally only error messages and a limited number of startup messages are logged.

The “syslog” protocol is used to send the messages. Any host system with a syslog facility may be used to collect the messages. Most Unix and Linux system have syslog capability and there are both free and commercial syslog programs for Windows.

Specifying the loghost with an IP number of `0.0.0.0` or with a name of “none” disables the syslog messages. The system is configured at the factory with the syslog messaging disabled.

To set a loghost use the command

```
> loghost aaa.bbb.ccc.ddd
```

or

```
> loghost hostname.domainname
```

where `aaa.bbb.ccc.ddd` is the IP address of the loghost in the usual “dotted quad” format, or `hostname.domainname` is the hostname and domain name of the loghost. Note that there is no default domain name so it must be explicitly specified with the hostname.

## 2.3 Factory Configuration

The modems are set at the factory to the following standard configuration:

Dash.....as indicated on the label  
Mute .....on (no output)  
TX Frequency  
-1 .....5093.0 MHz  
-2 .....5147.0 MHz  
RX Frequency  
-1 .....5147.0 MHz  
-2 .....5093.0 MHz  
Modulation .....on  
TX Power .....+27 dBm  
Interleave .....0  
RSL Threshold .....-110 dBm  
Temp Alarm Threshold .....50°C  
Channel.....serial  
Speed .....64 Kbps synchronous  
TX Clock  
-1 .....looped  
-2 .....internal  
Interface.....EIA-530  
Mode.....point-to-point  
Loopback.....off  
Operator password.....oper  
Administrator password .....admin  
Spare password.....spare  
Hostname.....protium  
DHCP .....on  
IP .....0.0.0.0  
Netmask.....255.255.255.0  
Gateway.....192.168.0.1  
DNS  
primary .....192.168.0.1  
secondary .....0.0.0.0  
Timeserver.....us.pool.ntp.org  
Loghost.....0.0.0.0

## 3 Monitoring Operation

### 3.1 Alarms

The modem detects various abnormal conditions and generates an alarm to alert operators to the condition. The alarm conditions are grouped in to four categories: system, data, transmit, and receive alarms. Each category is associated with a status LED on the front and rear panels and with a solid-state relay contact closure. The specific conditions that generate each alarm are described below.

The system alarm status LED is green and is normally illuminated. It is extinguished when there is a system alarm or when any of the other alarm categories are asserted. Thus a no-alarm condition is easily identified by the green system LED on the panel being illuminated. Conversely, an alarm condition is easily identified by the green status LED being extinguished.

The other three alarm categories have a corresponding amber status LED that illuminates when an alarm condition is detected. Multiple alarm conditions may be present so more than one alarm LED may be illuminated.

Each of the four alarm categories also has a corresponding solid-state relay contact closure. The system alarm contact closure is normally closed while the other three contact closures are normally open.

The alarm status may be examined with the **alarm** command that displays the specific condition generating an alarm, if any. The **alarm** command will also indicate the cause of any transient alarm that may have occurred but is now cleared.

#### 3.1.1 System Alarms

|                        |  |
|------------------------|--|
| High Modem Temperature | The temperature on the modem board exceeds the set high temperature threshold. The factory set threshold is 50°C but may be independently adjusted as desired.                 |
| High RF Temperature    | The temperature of the RF module exceeds the set high temperature threshold. The factory set threshold is 50°C but may be independently adjusted as desired.                   |
| High PA Temperature    | The temperature of the transmitter power amplifier exceeds the set high temperature threshold. The factory set threshold is 50°C but may be independently adjusted as desired. |

#### 3.1.2 Data Alarms

|               |   |
|---------------|---|
| No Frame Lock | The modem is not able to achieve frame lock on the incoming data. No frame lock may indicate a poor receive signal or mismatched configuration settings between the two ends of the link. |
|---------------|---|

#### 3.1.3 Transmit Alarms

|                         |   |
|-------------------------|---|
| Muted                   | The transmitter is muted because of a configuration problem or a transmit synthesizer problem.                                  |
| Synthesizer Out of Lock | The transmit synthesizer is out of lock. This may indicate an unconfigured or misconfigured transmitter, or a hardware failure. |
| No Transmit Power       | No transmit power is detected.  |
| Low Transmit Power      | The detected transmit power reading is less than 80% of its nominal value.  |

### 3.1.4 Receive Alarms

|                         |   |
|-------------------------|---|
| Synthesizer Out of Lock | The receive synthesizer is out of lock. This may indicate an unconfigured or misconfigured receiver, or a hardware failure.   |
| AGC Out of Lock         | The automatic gain control system is not able to achieve a suitable receive signal level.   |
| Low RSL                 | The receive signal level is below the set threshold level. The RSL is not a measured value but is inferred from the AGC system. The threshold level may be set by the administrator and should be set to an appropriate value depending on the expected operating conditions. |

## 3.2 Status

Useful status information may also be displayed by various commands including **rsl**, **stats**, and **temp**.

The **rsl** command continuously displays near real-time receive signal strength and may be used to “peak” the antenna positioning when installing the system.

The **stats** command displays statistics about the performance of the Forward Error Correction (FEC) mechanism. This information may be helpful in evaluating the quality of the RF link and the operating margin.

The **temp** command displays the current and peak temperatures measured in the RF module, the power amplifier, and the processor/modem.

See the description of each command below for details.

## 4 Local Craft Interface

### 4.1 Craft Interface Terminal Port

The modem has a Craft Interface Terminal (CIT) port that is used to configure it and monitor its operation. The user interface is a text-based “command line” style so that it is compatible with most laptop Personal Computers (PCs) and Personal Digital Assistants (PDAs). Terminal emulator software such as “HyperTerminal” or equivalent is required for the PC or PDA.

The physical interface is 9600 baud serial with a 9 pin female D-sub connector (DE-9F). The connector is configured as Data Communication Equipment (DCE) so a straight thru cable is used to connect to a typical PC or PDA.

In the following descriptions the authorization designation “RO” indicates the command is “read only” meaning the current value can be displayed but not changed. The designation “RW” indicates the command is “read / write” and the value can be both displayed and changed.

When a command is entered without an optional parameter, the current value is displayed. When the command is entered with a parameter, the value will be changed to the specified value.

In the following usage descriptions, optional parameters are shown enclosed in square brackets [ ]. Alternative parameters are shown in angle brackets < > and separated by a vertical bar. Unless otherwise noted, only one of the alternatives should be entered. Neither the angle brackets nor the vertical bar should be entered as part of the command.

### 4.2 Commands

#### 4.2.1 **alarms**      **Display Alarms**

Usage: alarms

Authorization: Operator RO; Administrator RO

Display alarm conditions, if any. Alarms that have been asserted since the last time this command was issued but are now de-asserted will be marked as “cleared.” This feature allows transient alarm condition to be “remembered” and more easily identified.

#### 4.2.2 **channel**      **Select Data Channel**

Usage: channel [<serial|ethernet>]

Authorization: Operator RW; Administrator RW

With no argument, displays the current data channel. Otherwise sets the data channel to the specified value.

The modem may carry either serial data or 10Base-T Ethernet data. A link speed of 128 Kbps is automatically selected when Ethernet traffic is being carried.

### 4.2.3 clear

#### Clear Screen

Usage: clear

Authorization: Operator RW; Administrator RW

Clear terminal screen.

### 4.2.4 clock

#### Clock Mode

Usage: clock [<intextlloop>]

Authorization: Operator RW; Administrator RW

Display or set the clock mode.

The clock mode is only applicable to synchronous communications. The synchronous transmit data may be aligned to a clock provided by the modem (“internal” clock), by the Data terminal Equipment (DTE) (“external” clock), or by the receiver (“looped-back” clock). The proper choice of clock mode depends on the requirements of the DTE.

With no argument, display the current clock mode. With an argument, set the clock mode to “int,” “ext,” or “loop.”

### 4.2.5 config

#### Configuration

Usage: config

Authorization: Operator RO; Administrator RO

Show current configuration settings summary.

### 4.2.6 dash

#### Dash Variation

Usage: dash [<1|2>]

Authorization: Operator RO; Administrator RW

Display or set “dash” variation.

There are two variations for the RF modem: one transmits on a higher frequency and receives on a lower frequency, and the other is the opposite. A link consists of one modem of each variation so that the receive frequency of each one can be tuned to the transmit frequency of the other. These two variations are called “dash one” and “dash two.”

A modem may be physically changed in the field from dash one to dash two, or vice versa, by following a specified procedure. After physically changing the modem, this command must be used to properly configure the software.

With no argument, display the current dash number setting. With an argument of “1” or “2” set the dash number as specified. When the dash number is specified, whether or not it is changed, the transmit and receive frequencies are set to zero. This is a precaution so the user must explicitly set the frequencies to ensure they are appropriate to the current variation.

### 4.2.7 dhcp

#### DHCP Enable

Usage: dhcp [<0|1>] [<nly|off|on>]

Authorization: Operator RO; Administrator RW

With no argument displays the current DHCP enable setting. Otherwise sets the DHCP enable to the specified value.

DHCP is a protocol that permits an Ethernet device to have its IP port configuration set automatically. When DHCP is enabled, at startup the modem will request IP configuration information from a DHCP server. If DHCP is enabled the customer is responsible for providing a DHCP server that will supply the necessary configuration information or the Ethernet port will not work.

If DHCP is disabled, the IP number, netmask, gateway, and DNS configuration must be set manually.

Note: the 0/1 refers to the RMS Ethernet port (0) or the payload Ethernet port (1). Although there is a setting for the payload port, it is not used. The default port is 0, however, so entering a 0 or 1 is unnecessary and is only documented for the sake of completeness.

### 4.2.8 dns

#### Domain Name Server

Usage: dns [<pr|sec>] [nnn.nnn.nnn.nnn]

Authorization: Operator RO; Administrator RW

With no argument, displays the IP address of the domain name server(s). Otherwise sets the domain name server address to the specified value.

A domain name server, or DNS, is required for the RMS Ethernet port to locate other networked systems by name. It is possible to set a primary and a secondary name server. If not specified, primary is the default.

If DHCP is enabled, the DNS should be set automatically.

A DNS setting is optional. If it is not needed, an IP number of 0.0.0.0 may be entered.

### 4.2.9 gateway

#### Network Gateway

Usage: gateway [<nnn.nnn.nnn.nnn|hostname.domain>]

Authorization: Operator RO; Administrator RW

With no argument, displays the default IP gateway. Otherwise sets the default gateway to the specified value.

To communicate beyond the local network, the IP communication must go through an IP router. This command allows a default router to be specified to handle any communication beyond the local network.

The gateway may be specified as a “dotted quad” IP number (nnn.nnn.nnn.nnn) or as a hostname (and domain). If specified as a hostname, a DNS server must be available to resolve the name into an IP number.

#### 4.2.10 help / ?

##### Help

Usage: help [<radiodatalink|network|admin|all>]

Usage: ? [<radiodatalink|network|admin|all>]

Authorization: Operator RO; Administrator RO

Display brief help information about available commands. Help without an argument displays the top level help screen. With an argument, displays help screen for commands related to a specific topic:

|          |                                     |
|----------|-------------------------------------|
| radio    | radio configuration and performance |
| datalink | data channel configuration          |
| network  | network configuration               |
| admin    | administrative commands             |

#### 4.2.11 hostname

##### Hostname

Usage: hostname [hostname]

Authorization: Operator RO; Administrator RW

With no argument, displays the network hostname for this modem. Otherwise sets the hostname to the specified value.

#### 4.2.12 ident

##### Identify

Usage: ident

Authorization: Operator RO; Administrator RO

Display product identification information.

#### 4.2.13 interface

##### Interface Driver

Usage: interface [<232|530>]

Authorization: Operator RO; Administrator RW

Display or set the interface driver/receiver type.

The interface drivers and receivers may be configured to either EIA-232 (single ended) or EIA-530 (differential) standards. Either style of driver may be used with either the asynchronous or synchronous protocol.

#### 4.2.14 interleave

##### Interleave Data Blocks

Usage: interleave [<0|1|2|3|4|5|6>]

Authorization: Operator RO; Administrator RW

With no argument, displays the current interleave depth. Otherwise set the interleave depth to the specified value.

Data blocks may be interleaved to improve the error performance in the presence of certain kinds of noise and interference. The optimum interleave depends on the characteristics of the noise and interference and selecting the optimum interleave depth is beyond the scope of this document.

Increasing the interleave depth increases the latency of the link.

Depth of 0 and 1 are equivalent and mean interleaving is off.

#### 4.2.15 ip

#### Internet Protocol Address

Usage: ip [<0|1>] [nnn.nnn.nnn.nnn]

Authorization: Operator RO; Administrator RW

With no argument, display the current manual IP address. Otherwise, set the manual IP address to the specified value.

The IP address is required for the RMS Ethernet port to communicate. If DHCP is disabled then the IP address must be set manually using this command. A unique address must be assigned to each device on the network.

If DHCP is enabled, this setting is ignored. The value reported here DOES NOT represent the IP address established by the DHCP server.

Note: the 0/1 refers to the RMS Ethernet port (0) or the payload Ethernet port (1). Although there is an IP address setting for the payload port, it is not used. The default port is 0, however, so entering a 0 or 1 is unnecessary and is only documented for the sake of completeness.

#### 4.2.16 loghost

#### Loghost Address

Usage: loghost [<nn.nn.nn.nnnhostname.domain>]

Authorization: Operator RO; Administrator RW

With no value specified, display the current setting of the loghost. Otherwise set the loghost to the specified value. The loghost may be specified as a “dotted quad” IP address, or as a hostname and domain. The change will take effect when the system is restarted.

Specifying the loghost with an IP number of 0.0.0.0 or with a name of “none” disables the syslog messages. The system is configured at the factory with the syslog messaging disabled

The modem will send system error messages to the specified remote loghost on UDP port 514 using the “syslog” protocol. Use of this feature is completely optional, although it may be useful for monitoring or troubleshooting since a system console is not provided.

Any host system with a syslogd facility may be used to collect the messages. Most Unix and Linux system have syslogd capability and there are both free and commercial syslogd programs for Windows. (See, for example, <http://www.kiwisyslog.com>.)

#### 4.2.17 loop

#### Loopback Mode

Usage: loop [<0|1|nly|off|on>]

Authorization: Operator RW; Administrator RW

Display or set the current loopback mode.

With no argument, displays the current loopback setting. With an argument of 0, n, or “off” sets the loopback to off. With an argument of 1, y, or “on” sets the loopback mode to on.

There are three loopback functions: local, remote, and traffic. Local loopback connects the serial data port output (RD) to the serial port input (TD). This is useful for testing the data interface lines, receivers, and drivers.

Remote loopback connects the

#### 4.2.18 mac

#### Media Access Control (MAC) Address

Usage: mac [<0|1>]

Authorization: Operator RO; Administrator RO

Display the Ethernet port MAC address.

Every Ethernet device is required to have a unique MAC or “hardware” address. This address is assigned by the manufacturer and is set at the factory.

The RMS and payload Ethernet ports have separate MAC addresses. The 0 or 1 will select which is displayed. If not specified, the RMS port (0) is displayed.

#### 4.2.19 mod

#### Modulation

Usage: mod [<0|1|nly|off|on>]

Authorization: Operator RO; Administrator RO

With no argument, displays the current modulation setting. With an argument of 0, n, or “off” sets the modulation to off. With an argument of 1, y, or “on” sets the loopback mode to on.

#### 4.2.20 multipoint

#### Multipoint Handshaking

Usage: multipoint [<0|1|nly|off|on>]

Authorization: Operator RW; Administrator RW

With no value specified, display the current multipoint setting. Otherwise, set the multipoint setting to the specified value. Multipoint on indicates point-to-multipoint mode; multipoint off indicates point-to-point mode.

The modems support point-to-point and point-to-multipoint communication modes. In point-to-multipoint mode, only one of the multipoint modems may transmit at any given time. This is controlled by the RTS (request-to-send) control line at the EIA-530/-232 DB-25 port.

When a multipoint modem has permission to transmit, it should assert RTS and wait for the modem to respond by asserting CTS (clear-to-send).

In multipoint mode the RF transmitter will be unmuted when RTS is asserted and, after delay to allow the link to be established, CTS will be asserted to indicate it is okay to send data. The transmitter will be muted when RTS is negated.

Arbitration among the multipoint modems for access to the link is a higher level network function and the responsibility of the customer.

Multipoint mode does not affect the operation of the receiver. The receiver is on whether or not the multipoint modems is transmitting and all multipoint modems may receive simultaneously.

#### 4.2.21 mute

##### **Mute the RF output**

Usage: mute [☐|☐|nly|off|on>]

Authorization: Operator RO; Administrator RW

Display or set the mute state.

With no argument, displays the current mute setting. With an argument of 0, n, or off sets the mute to “off” (enables RF output). With an argument of 1, y, or on sets the mute to “on” (disables RF output).

#### 4.2.22 netconfig

##### **Network Configuration Summary**

Usage: netconfig

Authorization: Operator RO; Administrator RO

Display the current network configuration summary.

#### 4.2.23 netmask

##### **Network Mask**

Usage: netmask [☐|☐|>] [nnn.nnn.nnn.nnn]

Authorization: Operator RO; Administrator RW

With no value specified, display the current network mask. Otherwise set the network mask to the specified value. The change will take effect when the system is restarted.

The IP address consist of a “network” portion and a “host” portion. The network mask defines how much of the address is used for each one. A typical value for the network mask is 255.255.255.0.

If DHCP is enabled, this setting is ignored. The value reported here DOES NOT represent the network mask established by the DHCP server.

Note: the 0/1 refers to the RMS Ethernet port (0) or the payload Ethernet port (1). Although there is a network mask setting for the payload port, it is not used. The default port is 0, however, so entering a 0 or 1 is unnecessary and is only documented for the sake of completeness.

#### 4.2.24 passwd

#### Set Passwords

Usage: passwd <operladminlspare>

Authorization: see text

Change login passwords.

There are three user accounts: operator, administrator, and spare. The account is automatically identified by the password that is used to log in.

The operator account may change only the operator password; the administrator and the spare account may change any of the passwords.

The administrator and spare accounts are equivalent. It is suggested the spare account be used only as a backup in case the other passwords are lost.

The factory passwords are “oper”, “admin”, and “spare”. They are obviously not secure and should be changed. New passwords are subjected to specified complexity tests and must meet the specified requirements or will be rejected.

#### 4.2.25 rsl

#### Received Signal Level

Usage: rsl

Authorization: Operator RO; Administrator RO

Display the current received signal level.. This display is updated continuously until the return/enter key is pressed.

#### 4.2.26 rslthr

#### RSL Alarm Threshold

Usage: rslthr [-nnn.n]

Authorization: Operator RO; Administrator RW

Display or set the received signal level alarm threshold.

If the RSL falls below the specified value, a low received signal alarm is declared.

Without an argument, display the current RSL threshold.

With a numeric argument, sets the RSL alarm threshold to -nnn.n dBm.

#### 4.2.27 rxfreq

#### Receive Frequency

Usage: rxfreq [ffff.f]

Authorization: Operator RO; Administrator RW

Display or set the receive frequency.

With no argument, display the current receive frequency.

With a numeric argument, set the frequency to “ffff.f” MHz. The frequency may be specified in 0.1 MHz (100 KHz) steps. The minimum and maximum frequency depends on the dash variation of the modem:

| DASH | MINIMUM    | MAXIMUM    |
|------|------------|------------|
| -1   | 5140.0 MHz | 5150.0 MHz |
| -2   | 5091.0 MHz | 5101.0 MHz |

#### 4.2.28 speed

##### Set Interface Speed

Usage: speed [<300|600|1200|2400|4800|9600|19200|64|128>]

Authorization: Operator RW; Administrator RW

Display or set the interface speed.

With no argument, display the current interface speed.

With an argument, set the interface speed to the specified value. If the specified speed is “64” or “128” then the speed is set to 64,000 or 128,000 bits per second respectively and the protocol is set to synchronous. If the specified speed is 300 – 19200, the protocol is set to asynchronous.

If the speed is 128 Kbps synchronous, the link speed is also set to 128 Kbps. In all other cases the link speed is set to 64 Kbps.

#### 4.2.29 stats

##### Error Correction Statistics

Usage: stats [<0|clr>]

Authorization: Operator RO; Administrator RW

With no argument, displays the error correction statistics. With an argument of zero or “clr” resets the statistics counters to zero.

The display includes the following information:

|                   |   |  |
|-------------------|---|--|
| Elapsed seconds:  | 0 | Seconds since the counters were last cleared. This time continues to increment whether or not a link is established.   |
| Total bytes:      | 0 | Total bytes processed. This counts actual payload data in synchronous serial mode. In asynchronous serial and Ethernet modes this counter include “filler” bytes transmitted when there is no real data. |
| Corrected bytes:  | 0 | The number of bytes corrected by the error correction logic.   |
| Total blocks:     | 0 | The total number of block processed by the error correction logic. A block contains up to 200 actual data bytes.   |
| Errored blocks:   | 0 | The number of blocks that had a detected error.  |
| Uncorrected blks: | 0 | The number of blocks that had uncorrectable errors.  |
| Corrected blocks: | 0 | The number of blocks that had corrected errors.  |

If there are any corrected blocks, a table is printed indicating how many blocks had one error, how many had two errors, and so forth.

#### 4.2.30 status

#### Status

Usage: status

Authorization: Operator RO; Administrator RO

Display information about the operation of the modem.

#### 4.2.31 temp

#### Temperature

Usage: temp

Authorization: Operator RO; Administrator RO

Display the temperature of the modem, the RF module, and the power amplifier.

#### 4.2.32 tempthr

#### Temperature Alarm Thresholds

Usage: tempthr [<rf|pa|modem>] [nn]

Authorization: Operator RO; Administrator RW

If the temperature argument (nn) is absent, display the current temperature alarm thresholds. Otherwise sets the temperature alarm threshold to nn°C.

If one or more of the identifiers “rf”, “pa”, or “modem” is present the command applies only to the specified subsystem(s). If none is specified, the command applies to all subsystems.

An excessive temperature reading in the RF module, the power amplifier, or the modem board will generate a system alarm condition. The factory set threshold for the alarm is 50°C but this may be changed with this command.

#### 4.2.33 testmode

#### Test LEDs, Fans, Relays

Usage: testmode [

Authorization: Operator RW; Administrator RW

With no argument, display the current state of the test mode. Otherwise set the test mode on or off as specified.

When the test mode is on, all the front and rear panel status LEDs will be turned on, both fans will be turned on, and the alarm relays will be inverted.

The operation of the modem will be unaffected. If it is operational it will continue to operate when test mode is on. Note, however, that the inverted state of the alarm relays may externally affect the operation of the modem.

#### 4.2.34 timeserver

#### Time Server

Usage: timeserver [<nn.nn.nn.nnlhostname.domain>]

Authorization: Operator RO; Administrator RW

With no value specified, display the current setting of the time server. Otherwise set the time server to the specified value. The change will take effect when the system is restarted.

The time server may be specified as a “dotted quad” IP address, or as a hostname and domain.

When the system is started, it will attempt to contact the specified time server using Network Time Protocol (NTP) in order to set the modem’s internal time and date. An accurate time and date is optional and not necessary for the modem’s operation but it may be useful for timestamping messages in various system logs.

If the timeserver is not specified, or if the attempt to contact the timeserver is not successful, the modem’s time and date starts at 00:00 on 1-Jan-1970.

#### 4.2.35 txfreq

#### Transmit Frequency

Usage: txfreq [ffff.f]

Authorization: Operator RO; Administrator RW

Display or set the transmit frequency.

With no argument, display the current transmit frequency.

With a numeric argument, set the frequency to “ffff.f” MHz. The frequency may be specified in 0.1 MHz (100 KHz) steps. The minimum and maximum frequency depends on the dash variation of the modem:

| DASH | MINIMUM    | MAXIMUM    |
|------|------------|------------|
| -1   | 5091.0 MHz | 5101.0 MHz |
| -2   | 5140.0 MHz | 5150.0 MHz |

#### 4.2.36 txpower

#### Transmit Power Level

Usage: txpower [nn.n]

Authorization: Operator RO; Administrator RW

Display or set the current transmit power setting.

With no argument, displays the current transmit power setting. With a numeric argument, sets the transmit power level to nn.n. The power level is specified in dBm. Although tenths of a dBm may be specified on the command line, the power level will be set to the next lower 0.5 dBm setting. The maximum power level is 30.0 dBm.

#### 4.2.37 uptime

#### System Uptime

Usage: uptime

Authorization: Operator RO; Administrator RO

Display the system “uptime” – the time since the modem was first started. Also displays the modem’s current time (“wall” time) which will only be meaningful if it has been successfully set using a timeserver. See the timeserver command description.

Processor loading information is also shown but it is generally uninteresting.

#### **4.2.38 version**

#### **Version**

Usage: version

Authorization: Operator RO; Administrator RO

Display the version of the software modules in the modem.

### **4.3 Privileged Commands**

There is a set of privileged commands reserved for use by trained technicians and other knowledgeable users. These commands are available by logging in with a special password. These commands should be used with care. The password should be treated accordingly.

#### **4.3.1 Netflash**

#### **Update Software via the Network**

Usage: netflash <IP[ filename]http://website/filename>

Authorization: Privileged

Update the user interface and operating system software.

This command will read a new software file over the RMS network connection. If the file is successfully downloaded as determined by checksum, the new file will be written to the program FLASH memory and will be run the next time the system is started.

Note: there is only one program area. If the wrong program is loaded, or if the process of writing the file to FLASH is interrupted, the modem is likely to become non-functional the next time it is started and must be returned to the factory for reprogramming.

The source of the update may be specified as an IP number, in which case a TFTP server with the update file will be expected. If the filename is not specified, a file name of “image.bin” is assumed. The TFTP server must be provided by the customer and may be on a local network or even an appropriately configured laptop computer.

Alternatively, the update may be specified as a URL and loaded from a web server. From time to time Protium Technologies, Inc. may make software updates available on its web server for downloading via the Internet.

#### **4.3.2 Syslog**

#### **System Logging**

Usage: syslog [<nonelinfoldebug>]

Authorization: Privileged

With no argument, display the current system logging level. Otherwise, set the specified system logging level.

Multiple arguments may be specified, in which case each argument is applied in the order given. For example,

syslog none debug

will clear all optional logging and then enable logging of debug messages.

The modem sends system messages to a syslog host if one is specified. When a host is specified, the messages are sent using the “syslog” UDP protocol to port 514. Syslog messages are categorized in to multiple levels based on the severity of the condition and the importance of the message. The “info” and “debug” log level messages are optional and are disabled by default. All other messages levels are considered error messages and are always enabled.

The “info” and/or “debug” log levels may be useful for debugging in certain limited circumstances but should otherwise be off.

### **4.3.3 agc**

#### **Automatic Gain Control**

Usage: agc

Authorization: Privileged

Display the AGC on/off setting.

### **4.3.4 apc**

#### **Automatic Power Control**

Usage: apc

Authorization: Privileged

Display the APC on/off setting.

### **4.3.5 atten**

#### **Attenuation Setting**

Usage: atten

Authorization: Privileged

Display the current attenuation setting.

### **4.3.6 dev**

#### **Deviation Setting**

Usage: dev

Authorization: Privileged

Display the current deviation setting.

### **4.3.7 dev128**

#### **Deviation Calibration 128 Kbps**

Usage: dev128

Authorization: Privileged

Display the calibrated deviation setting for 128 Kbps link speed.

#### **4.3.8 dev64**

#### **Deviation Calibration 64 Kbps**

Usage: dev64

Authorization: Privileged

Display the calibrated deviation setting for 64 Kbps link speed.

#### **4.3.9 pwrcal**

#### **TX Power Calibration**

Usage: pwrcal

Authorization: Privileged

Display the calibrated TX power setting.

#### **4.3.10 pwrdet**

#### **TX Power Detector Reading**

Usage: pwrdet

Authorization: Privileged

Display the current reading from the transmit power detector.

#### **4.3.11 rslcal**

#### **RSL Calibration**

Usage: rslcal

Authorization: Privileged

Display the RSL calibration value.

#### **4.3.12 tcxo**

#### **TCXO Calibration**

Usage: tcxo

Authorization: Privileged

Display the TCXO calibration value.

## 5 Specifications

### System

|                                   |                               |
|-----------------------------------|-------------------------------|
| Frequency Range                   | 5091 - 5150 MHz               |
| T/R Spacing                       | 54 or 49 MHz                  |
| Capacity                          | 64/128 kb/s                   |
| Occupied Bandwidth                | 100/200 kHz                   |
| Modulation Type                   | Modified Duobinary CPM        |
| Forward Error Correction          | Reed-Solomon                  |
| Interleaving                      | Selectable 0 - 6              |
| Link Acquisition Time             | Less than 5 seconds           |
| Power Supply                      | 20 to 60 VDC, either polarity |
| Power Consumption                 | <30 Watts                     |
| System Gain @10 <sup>-6</sup> BER | 128/126 dB                    |
| Operating Modes                   | Full/half Duplex              |

### Transmitter

|                        |                             |
|------------------------|-----------------------------|
| Transmitter Source     | Fully Synthesized           |
| Frequency Tolerance    | < 2.5 ppm                   |
| Tuning Steps           | 0.1 MHz                     |
| Output Power           | 30 dBm                      |
| Power Adjustment Range | >20 dB, 1 dB Steps          |
| Spectral Compliance    | NTIA Spectrum Manual, Ch. 5 |
| Tx Mute                | <-50 dBm                    |

### Receiver

|                                     |                      |
|-------------------------------------|----------------------|
| Receiver Source                     | Fully Synthesized    |
| Frequency Tolerance                 | <2.5 ppm             |
| Tuning Steps                        | 0.1 MHz              |
| Rx Threshold @ 10 <sup>-6</sup> BER | -98/-96 dBm          |
| Dynamic Range                       | > 70 dB              |
| Maximum Input (without damage)      | +10 dBm              |
| Residual BER                        | <1x10 <sup>-10</sup> |

### Interfaces

|                                      |  |
|--------------------------------------|--|
| Data                                 | EIA-530, EIA-232 (DB-25F, DCE) or IEEE 802.3 (RJ-45) |
| SNMP                                 | IEEE 802.3 (RJ-45)                                   |
| Local Craft Interface Terminal (CIT) | EIA-232, 9600 bps (DE-9F, DCE)                       |
| Alarms                               | 8 pin mini-DIN, 4 form A contact pairs               |
| Antenna                              | Type N   |

### Unit Management and Diagnostics

|           |                        |
|-----------|------------------------|
| Local CIT | Command line interface |
| SNMP      | Version 1 and 3        |

### Physical Characteristics

|           |                      |
|-----------|----------------------|
| Unit Size | 1.8"H x 9.5"W x 12"D |
| Weight    | 5.0 lb.              |

### Environmental

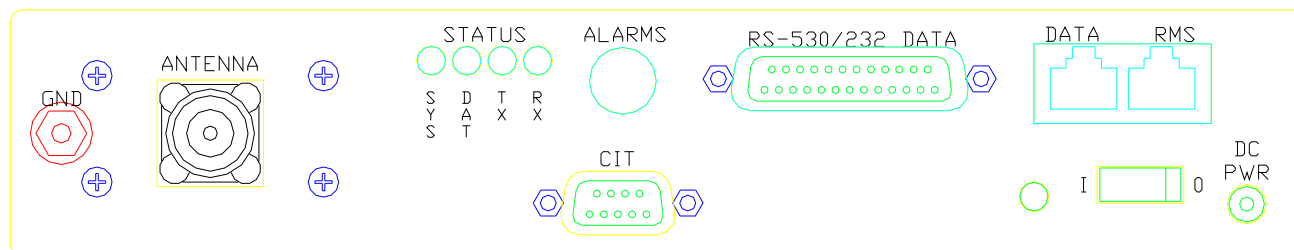
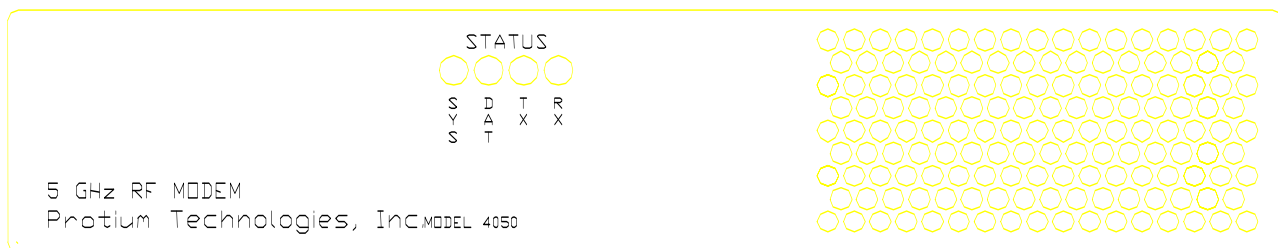
|                   |                                     |
|-------------------|-------------------------------------|
| Temperature Range | 0 - 50°C, 0 – 70°C Reduced Tx Power |
| Humidity          | 0 - 95% non-condensing              |
| Shock             | per IEC-68-2-27                     |
| Vibration         | per IEC-68-2-6                      |

### EMC

|           |   |
|-----------|---|
| Immunity  | per IEC 61000-4-2,3,5,6                     |
| Emissions | Compliant with FCC Part 15, Class A Devices |

## 6 Connectors

### 6.1 Front & Rear Panels



## 6.2 Pin-out Tables

### 6.2.1 Data Port

| EIA-232 |      |        |                                       |
|---------|------|--------|---------------------------------------|
| PIN     | NAME | SOURCE | FUNCTION                              |
| 1       | FG   |        | Chassis Ground                        |
| 2       | TD   | DTE    | Transmit Data to Modem                |
| 3       | RD   | DCE    | Receive Data from Modem               |
| 4       | RTS  | DTE    | Request to Send to Modem              |
| 5       | CTS  | DCE    | Clear to Send from Modem              |
| 6       | DSR  | DCE    | Data Set Ready from Modem             |
| 7       | SG   |        | Signal Ground                         |
| 8       | DCD  | DCE    | Receive Line Signal Detect from Modem |
| 9       |      |        |                                       |
| 10      |      |        |                                       |
| 11      |      |        |                                       |
| 12      |      |        |                                       |
| 13      |      |        |                                       |
| 14      |      |        |                                       |
| 15      | TC   | DCE    | Transmit Clock from Modem             |
| 16      |      |        |                                       |
| 17      | RC   | DCE    | Receiver clock from Modem             |
| 18      | LL   | DTE    | Loopback to Modem                     |
| 19      |      |        |                                       |
| 20      | DTR  | DTE    | Data Terminal Ready to Modem          |
| 21      |      |        |                                       |
| 22      |      |        |                                       |
| 23      |      |        |                                       |
| 24      | TCE  | DTE    | External Transmit Clock to Modem      |
| 25      |      |        |                                       |

| EIA-530 |         |        |                                       |         |
|---------|---------|--------|---------------------------------------|---------|
| PIN     | NAME    | SOURCE | FUNCTION                              | Pairing |
| 1       | SHIELD  |        | Shield Ground                         |         |
| 2       | TD(A)   | DTE    | Transmit Data to Modem                | 14      |
| 3       | RD(A)   | DCE    | Receive Data from Modem               | 16      |
| 4       | RTS(A)  | DTE    | Request to Send to Modem              | 19      |
| 5       | CTS(A)  | DCE    | Clear to Send from Modem              | 13      |
| 6       | DCR(A)  | DCE    | DCE Ready from Modem                  | 22      |
| 7       | SG      |        | Signal Ground                         |         |
| 8       | RLSD(A) | DCE    | Receive line Signal Detect from Modem | 10      |
| 9       | RSET(B) | DCE    | Receive Clock from Modem              | 17      |
| 10      | RLSD(B) | DCE    | Receive Line Signal Detect from Modem | 8       |
| 11      | TSET(B) | DTE    | Terminal Timing Clock to Modem        | 24      |
| 12      | TSET(B) | DCE    | Transmit Clock from Modem             | 15      |
| 13      | CTS(B)  | DCE    | Clear to Send from Modem              | 5       |
| 14      | TD(B)   | DTE    | Transmit Data to Modem                | 2       |
| 15      | TSET(A) | DCE    | Transmit Clock from Modem             | 12      |
| 16      | RD(B)   | DCE    | Receive Data from Modem               | 3       |
| 17      | RSET(A) | DCE    | Receive Clock from Modem              | 9       |
| 18      | LL      | DTE    | Local Loopback to Modem               |         |
| 19      | RTS(B)  | DTE    | Request to Send to Modem              | 4       |
| 20      | DTR(A)  | DTE    | DTE Ready to Modem                    | 23      |
| 21      |         |        |                                       |         |
| 22      | DCR(B)  | DCE    | DCE Ready from Modem                  | 6       |
| 23      | DTR(B)  | DTE    | DTE Ready to Modem                    | 20      |
| 24      | TSET(A) | DTE    | Terminal Timing Clock to Modem        | 11      |
| 25      | TM      | DCE    | Test Mode                             |         |

NOTE 1: The RF modem is DCE and drives those signals that originate in the DCE

## 6.2.2 Craft Interface Terminal (CIT) Port

| EIA-232 |      |      |
|---------|------|------|
| PIN     | NAME | ORIG |
| 1       | DCD  | DCE  |
| 2       | RD   | DCE  |
| 3       | TD   | DTE  |
| 4       | DTR  | DTE  |
| 5       | SG   |      |
| 6       | DSR  | DCE  |
| 7       | RTS  | DTE  |
| 8       | CTS  | DCE  |
| 9       | RI   | DCE  |

NOTE 1: The RF modem is DCE and drives those signals that originate in the DCE

## 6.2.3 Alarm Relays

| ALARMS |      |        |
|--------|------|--------|
| PIN    | NAME | STATE* |
| 4      | SYS1 | NC     |
| 6      | SYS2 |        |
| 3      | DAT1 | NO     |
| 1      | DAT2 |        |
| 2      | TX1  | NO     |
| 5      | TX2  |        |
| 8      | RX1  | NO     |
| 7      | RX2  |        |

\*Indicates contact status during normal operation

NOTE 1: Mating connector is male.

## 6.2.4 Ethernet

There are two 10Base-T Ethernet ports, one for management and one for carrying data. Both ports will auto-negotiate for either full- or half-duplex.

The connectors are standard RJ-45 wired as Media Dependent Interface Crossover (MDIX). The management port may be connected directly to a PC with a straight-through type CAT-5 cable provided the modem and PC networking parameters are configured appropriately.

A connection to a switch or hub may need a crossover type CAT-5 cable unless the switch or hub has auto-MDIX capability or an “uplink” port available.

## 6.2.5 Power

| DC POWER |      |          |
|----------|------|----------|
| PIN      | NAME | POLARITY |
| Center   | V1   | + or -   |
| Sleeve   | V2   | - or +   |

NOTE 1: Mating connector is 2.5 mm x 5.5mm x 11mm female

NOTE 2: Both pins are isolated from chassis ground.

NOTE 3: Input voltage 24 to 48 VDC

## 7 Software Licenses

### 7.1 Open Source Software

The operating system used by the Model 4050 is uClinux 2.4. This is derived from the Linux 2.4 kernel, which is copyrighted by Linus Torvalds and others and licensed under the GNU General Public License (GPL) Version 2.

The C library used in the system is uClibc, which is licensed under the GNU Library General Public License (LGPL) Version 2.

The GNU General Public License and Library General Public License themselves are copyrighted by the Free Software Foundation.

The port of uClinux to the Xilinx Microblaze processor is primarily the work of John Williams, [jwilliams@itee.uq.edu.au](mailto:jwilliams@itee.uq.edu.au), and most (if not all) of that work is copyrighted by him. These modifications to the kernel are derivative work and are consequently also licensed under the GNU GPL V2.

Device drivers, which are also generally considered to be part of the kernel, are claimed to be derivative works thereof and, as such, come under the GNU GPL V2 license. This includes the device drivers written or modified by Protium Technologies, Inc. for the Xilinx SPI peripheral and for a specialized character device peripheral. Other device drivers are copyrighted by their respective authors, most notably by John Williams who is responsible for modifying the device drivers for the Microblaze peripherals, by Xilinx, and by others.

Standard Linux application programs provided with the system are copyrighted and licensed individually and separately from the kernel. Each application source directory should be consulted for the copyright and software license terms that apply to that application package.

Copies of the GNU General Public License and the GNU Library General Public License are reproduced in Appendix B for the reader's convenience. These are provided for reference only. The definitive licenses are those that accompany the source code.

Source code is available to legitimate owners of Model 4050 hardware in accordance with the GNU GPL, LGPL, and other applicable licenses. Requests for source code may be sent to Protium Technologies, Inc., 181 Cedar Hill Street, Marlborough, MA 01752.

### 7.2 Protium Technologies, Inc. Software License

The various applications embedded in to the equipment that specifically operate and manage the Model 4050, including the command line user interface application, are original works and are Copyright 2005, 2006 by Protium Technologies, Inc. and are licensed in binary form for use only with the Model 4050 RF Modem.

The Protium Technologies, Inc. Software License is located in Appendix B1.

## 8 Warranty and Service Information

Protium Technologies, Inc.'s standard warranty is one year from the date of delivery, provided that the warranty labels have not been broken. Breaking the seals or opening the modem without the expressed, written consent of Protium Technologies, Inc. will automatically void the warranty.

Protium Technologies, Inc.'s liability for a warranty failure applies only to the equipment provided by Protium Technologies, Inc. and excludes all other remedies, including, without limitation, incidental consequential damages. Protium Technologies, Inc. is not responsible for any lost data, revenue, or any consequential damages associated with a warranty or non-warranty failure.

In the event of a defect in or failure of the Protium Technologies, Inc. product, the customer shall contact Protium Technologies, Inc. regarding the warranty claim. Protium Technologies, Inc. warrants to rework or repair the product at the Protium Technologies, Inc. facility in Marlborough, Massachusetts once it has been properly returned by the customer.

To process a warranty claim please contact Protium Technologies, Inc. at the following location:

Protium Technologies, Inc.  
181 Cedar Hill Street  
Marlborough, MA 01752  
Phone: 508-229-3666  
Facsimile: 508-229-3667  
[warranty@protiumtechnologies.com](mailto:warranty@protiumtechnologies.com)

## Appendix A Protium Technologies, Inc. Model 4050 MIB

```
PROTIUMTECH-PRODUCTS-MODEL4050-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, Integer32 FROM SNMPv2-SMI
    SnmpAdminString                                FROM SNMP-FRAMEWORK-MIB
    protiumTechProducts                            FROM PROTIUMTECH-MIB
;

protiumTechModel4050 MODULE-IDENTITY
    LAST-UPDATED "200510270000Z"
    ORGANIZATION "Protium Technologies, Inc."
    CONTACT-INFO
        "Protium Technologies, Inc.
        181 Cedar Hill Street
        Marlborough MA 01752
        508-229-3666
        snmp-mib@protiumtechnologies"
    DESCRIPTION
        "MIB objects for the agent module of the Model 4050 RF Modem"
    REVISION      "200510270000Z"
    DESCRIPTION   "First draft"
    ::= { protiumTechProducts 1 }

--
-- top level structure
--
protiumTechSystem          OBJECT IDENTIFIER ::= { protiumTechModel4050 1 }
    systemInfo              OBJECT IDENTIFIER ::= { protiumTechSystem 1 }
    systemConfig            OBJECT IDENTIFIER ::= { protiumTechSystem 2 }
    systemStatus            OBJECT IDENTIFIER ::= { protiumTechSystem 3 }
    systemStats             OBJECT IDENTIFIER ::= { protiumTechSystem 4 }
protiumTechAlarms          OBJECT IDENTIFIER ::= { protiumTechModel4050 2 }
    alarmInfo               OBJECT IDENTIFIER ::= { protiumTechAlarms 1 }
    alarmConfig             OBJECT IDENTIFIER ::= { protiumTechAlarms 2 }
    alarmStatus             OBJECT IDENTIFIER ::= { protiumTechAlarms 3 }
    alarmStats              OBJECT IDENTIFIER ::= { protiumTechAlarms 4 }
protiumTechRadio           OBJECT IDENTIFIER ::= { protiumTechModel4050 3 }
    radioInfo               OBJECT IDENTIFIER ::= { protiumTechRadio 1 }
    radioConfig             OBJECT IDENTIFIER ::= { protiumTechRadio 2 }
    radioStatus             OBJECT IDENTIFIER ::= { protiumTechRadio 3 }
    radioStats              OBJECT IDENTIFIER ::= { protiumTechRadio 4 }
    radioCalibration        OBJECT IDENTIFIER ::= { protiumTechRadio 5 }
protiumTechModem           OBJECT IDENTIFIER ::= { protiumTechModel4050 4 }
    modemInfo               OBJECT IDENTIFIER ::= { protiumTechModem 1 }
    modemConfig             OBJECT IDENTIFIER ::= { protiumTechModem 2 }
    modemStatus             OBJECT IDENTIFIER ::= { protiumTechModem 3 }
    modemStats              OBJECT IDENTIFIER ::= { protiumTechModem 4 }
protiumTechInterfaces      OBJECT IDENTIFIER ::= { protiumTechModel4050 5 }
    interfacesInfo          OBJECT IDENTIFIER ::= { protiumTechInterfaces 1 }
    interfacesConfig        OBJECT IDENTIFIER ::= { protiumTechInterfaces 2 }
    interfacesStatus        OBJECT IDENTIFIER ::= { protiumTechInterfaces 3 }
    interfacesStats         OBJECT IDENTIFIER ::= { protiumTechInterfaces 4 }
protiumTechManagement      OBJECT IDENTIFIER ::= { protiumTechModel4050 6 }
protiumTechPersistentConfig OBJECT IDENTIFIER ::= { protiumTechModel4050 7 }
protiumTechTestModes        OBJECT IDENTIFIER ::= { protiumTechModel4050 8 }
```

```
--
-- system objects
--

productIdentity OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..64))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Identification of the Protium Technologies product."
    ::= { systemInfo 1 }

productModelNumber OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..12))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Model number of the Protium Technologies product."
    ::= { systemInfo 2 }

productDescription OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..64))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Description of the Protium Technologies product."
    ::= { systemInfo 3 }

productManufacturer OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..64))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Manufacturer of the Protium Technologies product."
    ::= { systemInfo 4 }

serialNumber OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..12))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Serial number of this particular system."
    ::= { systemInfo 5 }

embeddedSoftwareVersion OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..24))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Version number of the embedded software. The format is flexible but
        is generally of the form <major>.<minor>.<revision> where major, minor,
        and revision are numeric fields. The major version identifies significant
        changes if capability or functionality. The minor version indicates
        a less significant change in functionality. The revision generally
        indicates a fix or improvement to existing functionality."
    ::= { systemInfo 6 }

modemSoftwareVersion OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..24))
    MAX-ACCESS  read-only
    STATUS      current
```

## DESCRIPTION

"Version number of the embedded software. The format is flexible but is generally of the form <major>.<minor>.<revision> where major, minor, and revision are numeric fields. The major version identifies significant changes if capability or functionality. The minor version indicates a less significant change in functionality. The revision generally indicates a fix or improvement to existing functionality."

```
::= { systemInfo 7 }
```

## radioSoftwareVersion OBJECT-TYPE

```
SYNTAX      OCTET STRING (SIZE(0..24))
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

## DESCRIPTION

"Version number of the embedded software. The format is flexible but is generally of the form <major>.<minor>.<revision> where major, minor, and revision are numeric fields. The major version identifies significant changes if capability or functionality. The minor version indicates a less significant change in functionality. The revision generally indicates a fix or improvement to existing functionality."

```
::= { systemInfo 8 }
```

## panelLEDs OBJECT-TYPE

```
SYNTAX      BITS { sysLED(0), dataLED(1), txLED(2), rxLED(3) }
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

## DESCRIPTION

"Status of the front and rear panel LED indicators. The system LED is normally on; the other LEDs are normally off."

```
::= { systemStatus 1 }
```

## relayContacts OBJECT-TYPE

```
SYNTAX      BITS { sysRelay(0), dataRelay(1), txRelay(2), rxRelay(3) }
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

## DESCRIPTION

"Status of the relay contacts. The system contact is normally closed (1); the other contacts are normally open."

```
::= { systemStatus 2 }
```

## coolingFans OBJECT-TYPE

```
SYNTAX      BITS { fan1(0), fan2(1) }
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

## DESCRIPTION

"Status of the cooling fans. The numbers of fans in operation is temperature dependent."

```
::= { systemStatus 3 }
```

## currentAlarms OBJECT-TYPE

```
SYNTAX      BITS { summary(0), modemTemp(1), rfTemp(2), paTemp(3),
                  linkDown(4),
                  txSynthOOL(5), txMuted(6), txNoPower(7), txLowPower(8),
                  rxSynthOOL(9), rxAgcOOL(10), rxLowRsl(11) }
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

## DESCRIPTION

"A collection of status bits indicating alarm conditions. The alarms are:  
summary inclusive OR of all the other alarms  
modemTemp the modem temperature exceeds the alarm threshold  
rfTemp the RF module temperature exceeds the alarm threshold"

```

        paTemp          the PA module temperature exceeds the alarm threshold
        linkdown        there is no frame lock on the receiver
        txSynthOOL      the TX frequency synthesizer is out of lock
        txMuted         the transmitter is muted
        txNoPower       no power is detected at the transmitter
        txLowPower      the transmitter power out is abnormally low
        rxSynthOOL      the RX frequency synthesizer is out of lock
        rxAgcOOL        the receiver automatic gain control has excessive error
        rxLowRsl        the receiver signal level is below the alarm threshold"
    ::= { alarmStatus 1 }

--
-- radio objects
--
radioMuteSetting OBJECT-TYPE
    SYNTAX      INTEGER { mute(0), unmute(1) }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Desired unmute setting."
    ::= { radioConfig 1 }

radioDashVariation OBJECT-TYPE
    SYNTAX      INTEGER { undefined(0), txlow(1), txhigh(2) }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Value of 1 indicates radio transmits in the low subband and
        receives in the high subband. A value of 2 indicates the radio
        transmits in the high subband and receives in the low subband.
        A value of zero indicates the radio has not been configured. An
        unconfigured radio will not transmit at all."
    ::= { radioConfig 2 }

radioTxFrequencySetting OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "KHz"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Transmit frequency in KHz."
    ::= { radioConfig 3 }

radioRxFrequencySetting OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "KHz"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Reveiver frequency in KHz."
    ::= { radioConfig 4 }

radioTxPowerSetting OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "cBm"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Transmit output power in cBm (centibels referred to 1 mW)."
    ::= { radioConfig 5 }

```

```
radioRslAlarmThreshold OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "cBm"
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "Low received signal alarm threshold in cBm (centibels referred to 1 mW)."
```

```
 ::= { radioConfig 6 }
```

```
radioTempAlarmThreshold OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "High temperature alarm threshold of the radio module in degrees C."
```

```
 ::= { radioConfig 7 }
```

```
powerAmpTempAlarmThreshold OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "High temperature alarm threshold of the power amplifier in degrees C."
```

```
 ::= { radioConfig 8 }
```

```
muteState OBJECT-TYPE
    SYNTAX      INTEGER { unmuted(0), mutedByOper(1), mutedByConfigErr(2),
                          mutedBySynthUnlocked(3), mutedForReconfig(4),
                          mutedByRTS }
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Actual mute state. The value is 1 if the radio is muted by operator
        command; the value is 2 if the operator has attempted to unmute the
        radio but it is prevented by mis-configuration (probably illegal TX
        frequency); the value is 3 if the frequency is okay but the synthesizer
        is out of lock; the value is 4 if the radio is temporarily muted while
        it is being reconfigured; the value is 5 if configured for multi-point
        and the request-to-send (RTS) line on the serial port is negated."
```

```
 ::= { radioStatus 1 }
```

```
txSynthLocked OBJECT-TYPE
    SYNTAX      INTEGER { unlocked(0), locked(1) }
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Transmit synthesizer lock state"
```

```
 ::= { radioStatus 2 }
```

```
rxSynthLocked OBJECT-TYPE
    SYNTAX      INTEGER { unlocked(0), locked(1) }
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Receive synthesizer lock state"
```

```
 ::= { radioStatus 3 }
```

```
receivedSignalLevel OBJECT-TYPE
    SYNTAX      Integer32
```

```
UNITS      "cBm"
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
    "Receive signal level in centibels referred to 1 mW."
 ::= { radioStatus 4 }

txAttenuationSetting OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Transmitter attenuation setting."
    ::= { radioStatus 5 }

txDeviationSetting OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Transmitter deviation setting."
    ::= { radioStatus 6 }

radioTemperature OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Temperature of the radio module in degrees C."
    ::= { radioStatus 7 }

powerAmpTemperature OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Temperature of the power amplifier in degrees C."
    ::= { radioStatus 8 }

peakRadioTemperaure OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Peak temperature of the radio module in degrees C."
    ::= { radioStats 7 }

peakPowerAmpTemperature OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Peak temperature of the power amplifier in degrees C."
    ::= { radioStats 8 }

deviation64K OBJECT-TYPE
    SYNTAX      Unsigned32(0..1023)
```

```
MAX-ACCESS    read-write
STATUS        current
DESCRIPTION
    "Deviation calibration setting for 64K link speed."
 ::= { radioCalibration 1 }

deviation128K  OBJECT-TYPE
    SYNTAX     Unsigned32(0..1023)
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "Deviation calibration setting for 128K link speed."
    ::= { radioCalibration 2 }

tcxoCalSetting OBJECT-TYPE
    SYNTAX     Unsigned32(0..1023)
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "TCXO calibration setting."
    ::= { radioCalibration 3 }

txAttenOffset  OBJECT-TYPE
    SYNTAX     Integer32(-32..31)
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "Transmit power calibration setting."
    ::= { radioCalibration 4 }

rslCalOffset   OBJECT-TYPE
    SYNTAX     Integer32(-32..31)
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "Inferred receive signal level calibration setting."
    ::= { radioCalibration 5 }

--
-- protiumTechModem objects
--

interleave     OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "Interleave factor: 0 through 6. Both 0 and 1 are no interleave"
    ::= { modemConfig 1 }

clearRsStats   OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "Clears Reed-Soloman statistics counters when read. Always reads 0."
    ::= { modemConfig 2 }

modemTempAlarmThreshold OBJECT-TYPE
    SYNTAX     Integer32
    UNITS      "degrees C"
```

```
MAX-ACCESS    read-write
STATUS        current
DESCRIPTION
    "High temperature alarm threshold of the modem module in degrees C."
 ::= { modemConfig 3 }

frameLocked OBJECT-TYPE
    SYNTAX      INTEGER { unlocked(0), locked(1) }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Receive frame lock state"
    ::= { modemStatus 1 }

modemTemperature OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Temperature of the modem board in degrees C."
    ::= { modemStatus 3 }

peakModemTemperature OBJECT-TYPE
    SYNTAX      Integer32
    UNITS       "degrees C"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Peak temperature of the modem board in degrees C."
    ::= { modemStatus 4 }

totalKBytes OBJECT-TYPE
    SYNTAX      Counter32

    UNITS       "KBytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Number of kilobytes processed by the R-S decoder
        (using the computer science definition of 1024 bytes
        per kilobyte)."
    ::= { modemStats 1 }

correctedBytes OBJECT-TYPE
    SYNTAX      Counter32

    UNITS       "bytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Number of bytes corrected by the R-S decoder."
    ::= { modemStats 2 }

totalBlocks OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder."
    ::= { modemStats 3 }
```

```
erroredBlocks OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that had errors."
    ::= { modemStats 4 }

uncorrectedBlocks OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that had uncorrectable errors."
    ::= { modemStats 5 }

correctedBlocks OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that had corrected errors."
    ::= { modemStats 6 }

errorHistogram OBJECT IDENTIFIER ::= { modemStats 7 }

blocksWithOtherErrs OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that had
        an unknown number of corrected errors. This should not
        happen."
    ::= { errorHistogram 0 }

blocksWith1Errs OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that
        had 1 corrected error byte."
    ::= { errorHistogram 1 }

blocksWith2Errs OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that
        had 2 corrected error bytes."
    ::= { errorHistogram 2 }

blocksWith3Errs OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that
```

```
        had 3 corrected error bytes."
    ::= { errorHistogram 3 }

blocksWith4Errs OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that
        had 4 corrected error bytes."
    ::= { errorHistogram 4 }

blocksWith5Errs OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that
        had 5 corrected error bytes."
    ::= { errorHistogram 5 }

blocksWith6Errs OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Number of blocks processed by the R-S decoder that
        had 6 corrected error bytes."
    ::= { errorHistogram 6 }

--
-- interfacesConfig objects
--

baudrate      OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "Asynchronous: 300 | 600 | 1200 | 2400 | 4800 | 9600 | 14400 | 19200
        Synchronous: 64 | 128"
    ::= { interfacesConfig 1 }

serialMode    OBJECT-TYPE
    SYNTAX      INTEGER { synchronous(0), asynchronous(1) }
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION
        "Serial port protocol. This is read-only because it is set
        implicitly by the baudrate"
    ::= { interfacesConfig 2 }

interfaceType OBJECT-TYPE
    SYNTAX      INTEGER { EIA530(0), EIA232(1) }
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "Interface driver type"
    ::= { interfacesConfig 3 }
```

```
clockSource OBJECT-TYPE
    SYNTAX      INTEGER { internal(0), external(1), looped(2) }
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "Synchronous serial clock source"
    ::= { interfacesConfig 4 }

--
-- protiumTechPersistantConfig objects
--

hostname OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..32))
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "hostname of the processor"
    ::= { protiumTechPersistantConfig 1 }

dnsServer1 OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "dotted quad of our primary DNS server"
    ::= { protiumTechPersistantConfig 2 }

dnsServer2 OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "dotted quad of our secondary DNS server"
    ::= { protiumTechPersistantConfig 3 }

defaultGateway OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "dotted quad of our default gateway"
    ::= { protiumTechPersistantConfig 4 }

timeserver OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..64))
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "host name (or IP number) of an ntp timeserver"
    ::= { protiumTechPersistantConfig 5 }

mgmtPortDhcpEnable OBJECT-TYPE
    SYNTAX      INTEGER { disabled(0), enabled(1) }
    MAX-ACCESS   read-write
    STATUS       current
    DESCRIPTION
        "If enabled, use DHCP to configure the management ethernet port"
    ::= { protiumTechPersistantConfig 6 }

mgmtPortIPv4Address OBJECT-TYPE
```

```
SYNTAX      IPAddress
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "dotted quad of management ethernet port if manually configured"
::= { protiumTechPersistantConfig 7 }

mgmtPortNetmask OBJECT-TYPE
SYNTAX      IPAddress
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "dotted quad of netmask for management ethernet port if manually configured"
::= { protiumTechPersistantConfig 8 }

mgmtPortHwAddress OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE(6))
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "Hardware MAC address for management ethernet port"
::= { protiumTechPersistantConfig 9 }

dataPortDhcpEnable OBJECT-TYPE
SYNTAX      INTEGER { disabled(0), enabled(1) }
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "If enabled, use DHCP to configure the management ethernet port"
::= { protiumTechPersistantConfig 10 }

dataPortIPv4Address OBJECT-TYPE
SYNTAX      IPAddress
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "dotted quad of payload ethernet port if manually configured"
::= { protiumTechPersistantConfig 11 }

dataPortNetmask OBJECT-TYPE
SYNTAX      IPAddress
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "dotted quad of netmask for payload ethernet port if manually configured"
::= { protiumTechPersistantConfig 12 }

dataPortHardwareAddress OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE(6))
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "Hardware MAC address for payload ethernet port"
::= { protiumTechPersistantConfig 13 }

--
-- testModes objects
--

panelLedTM OBJECT-TYPE
SYNTAX      INTEGER { normal(0), on(1) }
```

```
MAX-ACCESS read-write
STATUS current
DESCRIPTION
    "Test all panel LEDs. All Leds are forced on."
 ::= { protiumTechTestModes 1 }

alarmRelayTM OBJECT-TYPE
    SYNTAX INTEGER { normal(0), on(1) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Test all alarm relays. Alarm relay states are inverted."
    ::= { protiumTechTestModes 2 }

coolingFansTM OBJECT-TYPE
    SYNTAX INTEGER { normal(0), on(1) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Test both cooling fans. Both fans are forced on."
    ::= { protiumTechTestModes 3 }

loopbackTM OBJECT-TYPE
    SYNTAX INTEGER { off(0), local(1), remote(2), locrem(3), traffic(4) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Local loopback loops the interface receivers to the
        drivers. No modem functions are exercised.
        Remote loopback loops the received bit stream back to
        the transmitter. Symbol decoding and encoding are not
        exercised; Interleaving and error correction are not.
        Traffic loopback loops the local interface input to
        the local output. Serialization, deserialization,
        framing, interleaving, and error correction are all
        exercised; symbol encoding and decoding are not."
    ::= { protiumTechTestModes 4 }

rfLoopbackTM OBJECT-TYPE
    SYNTAX INTEGER { off(0), on(1) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Attempt RF loopback. Sets the receiver to the same
        frequency as the transmitter and set the transmitter
        to minimum power (maximum attenuation). Leakage may
        allow the radio to receive its own signal. Maybe."
    ::= { protiumTechTestModes 5 }

modulationTM OBJECT-TYPE
    SYNTAX INTEGER { normal(0), off(1) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Disable modulation and output a CW carrier."
    ::= { protiumTechTestModes 6 }

disableAgcTM OBJECT-TYPE
    SYNTAX INTEGER { normal(0), disabled(1) }
    MAX-ACCESS read-write
    STATUS current
```

```
DESCRIPTION
    "Disable receiver automatic gain control."
::= { protiumTechTestModes 7 }

disableApcTM    OBJECT-TYPE
    SYNTAX      INTEGER { normal(0), disabled(1) }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Disable the transmitter temperature compensated
        power control."
    ::= { protiumTechTestModes 8 }

disableRfModuleTM OBJECT-TYPE
    SYNTAX      INTEGER { normal(0), disabled(1) }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Communication with the RF module is disabled. The SPI bus
        to the PIC processor will not be used. The RF module remains
        in its current state."
    ::= { protiumTechTestModes 9 }

END
```

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Also, for each distributor's protection, we want to make certain  
that everyone understands that there is no warranty for this free  
library. If the library is modified by someone else and passed on, we

want its recipients to know that what they have is not the original version, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that companies distributing free software will individually obtain patent licenses, thus in effect transforming the program into proprietary software. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

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The reason we have a separate public license for some libraries is that they blur the distinction we usually make between modifying or adding to a program and simply using it. Linking a program with a library, without changing the library, is in some sense simply using the library, and is analogous to running a utility program or application program. However, in a textual and legal sense, the linked executable is a combined work, a derivative of the original library, and the ordinary General Public License treats it as such.

Because of this blurred distinction, using the ordinary General Public License for libraries did not effectively promote software sharing, because most developers did not use the libraries. We concluded that weaker conditions might promote sharing better.

However, unrestricted linking of non-free programs would deprive the users of those programs of all benefit from the free status of the libraries themselves. This Library General Public License is intended to permit developers of non-free programs to use free libraries, while preserving your freedom as a user of such programs to change the free libraries that are incorporated in them. (We have not seen how to achieve this as regards changes in header files, but we have achieved it as regards changes in the actual functions of the Library.) The hope is that this will lead to faster development of free libraries.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, while the latter only works together with the library.

Note that it is possible for a library to be covered by the ordinary General Public License rather than by this special one.

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"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

- a) The modified work must itself be a software library.
- b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.
- c) You must cause the whole of the work to be licensed at no

charge to all third parties under the terms of this License.

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

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5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also compile or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

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directing the user to the copy of this License. Also, you must do one of these things:

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- b) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.
- c) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.
- d) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

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- b) Give prominent notice with the combined library of the fact

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END OF TERMS AND CONDITIONS

## Appendix C GLOSSARY

|             |  |
|-------------|--|
| <b>BERT</b> | Bit-Error Rate Test. A test to determine the BER.  |
| <b>BER</b>  | Bit-Error Rate. The ratio of the number of incorrect bits received to the total number of bits received. The bit-error rate is usually expressed in scientific notation such as $1.0 \times 10^{-6}$ or 1.0E-6.  |
| <b>Bit</b>  | Binary “digit.” A bi-valued entity representing the smallest unit of information and generally represented by zero (“0”) or one (“1”).   |
| <b>bps</b>  | Bits Per Second.   |
| <b>byte</b> | Eight bits.  |
| <b>dB</b>   | Decibel. The ratio of two power levels expressed as ten times the base 10 logarithm of the ratio.  |
| <b>dBm</b>  | An absolute power measurement expressed as decibels relative to one milliwatt.   |
| <b>CIT</b>  | Craft Interface Terminal. A generic text-based terminal with an EIA-232 serial interface used for local management functions. This may be a dedicated text terminal, a personal computer with terminal emulator software, or a Personal Digital Assistant (PDA) with serial port and terminal emulator software.   |
| <b>DCE</b>  | Data Communications Equipment. The communication equipment, such as a modem, involved in a communication channel. Contrast with DTE.   |
| <b>DNS</b>  | Domain Name Server. A network server that provides a service to map network domain names to IP network addresses.  |
| <b>DHCP</b> | Dynamic Host Configuration Protocol. A network protocol used to automatically (and dynamically) configure an IP network port.  |
| <b>DTE</b>  | Date Terminal Equipment. The end node equipment involved in a communication channel. The DTE is the source and/or destination for the information sent over the communication channel. Contrast with DCE.  |
| <b>EIA</b>  | Electronic Industries Alliance.  |
| <b>FCC</b>  | Federal Communications Commission.   |
| <b>FEC</b>  | Forward Error Correction. A means by which errors that corrupt a message sent through a communication channel may be corrected. In FEC, redundant information is added to the message at the sender and processed at the receiver so that the original message may be recovered intact in spite of certain errors. |
| <b>GHz</b>  | Gigahertz. A frequency of 1,000,000,000 cycles per second.   |
| <b>GPL</b>  | GNU General Public License. A license agreement for open-source software (copyrighted by the Free Software Foundation).  |
| <b>IP</b>   | Internet Protocol.   |
| <b>Kbps</b> | Kilobits per second.   |
| <b>LGPL</b> | GNU Library General Public License. A license agreement for open-source software (copyrighted by the Free Software Foundation). The LGPL is typically used for libraries and other software “building blocks.”   |

|             |   |
|-------------|---|
| <b>MDIX</b> | Media Dependent Interface - Crossover. An Ethernet port connection using twisted pair cabling where a null-modem (or crossover) function is inherent in the pin assignments in the connector.   |
| <b>MIB</b>  | Management Information Base. The database of values, parameters, and events managed by SNMP for an entity (device).   |
| <b>MHz</b>  | Megahertz. A frequency of 1,000,000 cycles per second.  |
| <b>NTP</b>  | Network Time Protocol. An network protocol that allows real-time clocks to be synchronized via the network. Often used to synchronize local clocks to a standard reference.   |
| <b>RMS</b>  | Remote Management System. A generic reference to software used to manage (configure, monitor, and troubleshoot) the equipment remotely via a network connection.  |
| <b>RO</b>   | Read Only. A read-only value may be displayed but not changed.  |
| <b>RF</b>   | Radio Frequency.  |
| <b>RSL</b>  | Received Signal Level. The received signal power usually expressed in dBm.  |
| <b>RW</b>   | Read-Write. A read-write value may be displayed and changed.  |
| <b>SNMP</b> | Simple Network Management Protocol. A common protocol for managing devices via a network that is anything but simple.   |
| <b>SNR</b>  | Signal-to-Noise Ratio, expressed in dB.   |
| <b>TCP</b>  | Transmission Control Protocol. TCP is a layered protocol based on the Internet Protocol as its underlying protocol. TCP is connection and stream oriented. It provides for reliable communication over packet-switched networks by using flow control, packet retransmission, and other techniques. |

